

# The Capital Structure through the Modigliani and Miller Model

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## Abstract

The Modigliani-Miller theorem is not only his most important contribution to the theory of finance, but it is one of the most important results in the last half century of evolution of the financial economy, which among other things has certainly not been poor in contributions. important.

The Modigliani-Miller theorem concerns the financing choices of firms, and in particular the choice between debt and shares. It identifies the conditions under which the choice of issuing debt or shares to finance a given level of investments does not affect the value of companies, and therefore in which there is no optimal level of debt compared to the companies' own means. Therefore, it belongs to a class of surprising theorems of "neutrality" or "indifference" that exist in economics: these are theorems that show the irrelevance of a choice that at first sight would seem very important, such as that on the degree of debt of firms. Other theorems were developed after this: Trade-off, Pricing order and Market Timing.

**Keywords:** capital structure, M&M model

## 1. Introduction

By capital structure we mean the combination of the company's debt and equity (Brigham and Ehrhardt, 2008). To do this, companies can both collect external sources and recover profits by not distributing them to shareholders.

Through research, the optimal capital structure has been classified as a union between capital, debt and equity. This occurs either when the company maximizes its value or when it raises enough capital to not alter the structure itself (Brigham and Ehrhardt 2008). Myers (1984), states that the different theories on the structure of capital would not explain the financing behavior and, therefore, advises firms against the optimal capital structure when it is not possible to explain such behaviors.

Rajan and Zingales (1995) argue that profitability negatively affects financial leverage and this causes an increase in the size of the firm when this negative influence becomes stronger and stronger.

De Wet (2006), on the other hand, argues that the company with a lower WACC maximizes value as a whole.

M&M model of 1958 is the main focus of further studies on the structure of capital culminating in the work entitled “The Irrelevance Theorem” (Modigliani and Miller, 1958).

What do we really know about the choice of the corporate capital structure sixty-four years later? As Rajan and Zingales (1995, p. 1421) state: “The theory has clearly made progress on the subject. We now understand the most important deviations from the Modigliani and Miller assumptions that make the capital structure relevant to the value of a firm. However, very little is known about the empirical relevance of the different theories”.

For this reason, there are several theories on the subject.

The work is structured as follows: first of all, the M&M model is analyzed, after which, after analyzing some of the limits of this model, alternative theories to this model are described; in the final part, the conclusions are presented.

## 2. The Model of Modigliani and Miller

The M&M model is the best known model among the recipients of the Nobel Prize in economics. It is based on two propositions.

The first proposition states that the value of the indebted company is equal to the value of the non-indebted company, in the presence of a market with certain characteristics, such as: no taxes; absence of information

asymmetry or a condition in which information is fully shared between all individuals taking part in the economic process; individuals and businesses borrow at the same interest rate; absence of transaction costs or all those costs related to the organization of an activity and market in the form of strong efficiency.

Modigliani and Miller (1958) expressed this fact in a mathematical way:

$$V_j = (S_j + D_j) = \bar{X}_j / \rho_k \quad \text{or} \quad \frac{\bar{X}_j}{(S_j + D_j)} = \frac{\bar{X}_j}{V_j} = \rho_k \quad (1)$$

for each j-firm of class k where:

- $V_j$  market value of a company (market value of all stocks),
- $S_j$  market value of equity (issued stocks),
- $D_j$  market value of debt (issued bonds),
- $\bar{X}_j$  expected earning of assets (expected earning before interest),
- $\rho_k$  market realization rate of expected earning made by the company in its class.

Modigliani-Miller Proposition II states that debt increases the return required by shareholders on equity investment; therefore, the following are related: the cost of capital of an indebted company; the cost of capital in a company financed only with equity (equity); the cost of debt and the ratio of debt to equity, i.e. financial leverage.

(Miller and Modigliani, 1958). The mathematical expression is:

$$i_j = \rho_k + (\rho_k - \tau) D_j / S_j \quad (2)$$

where:

- $i_j$  expected rate on return of a common stock of j- company in k- class,
- $\rho_k$  market realization rate of expected return made by the companies of the given class,
- $\tau$  interest rate of the debt,
- $S_j$  market value of equity (issued stocks),
- $D_j$  market value of debt (issued bonds).

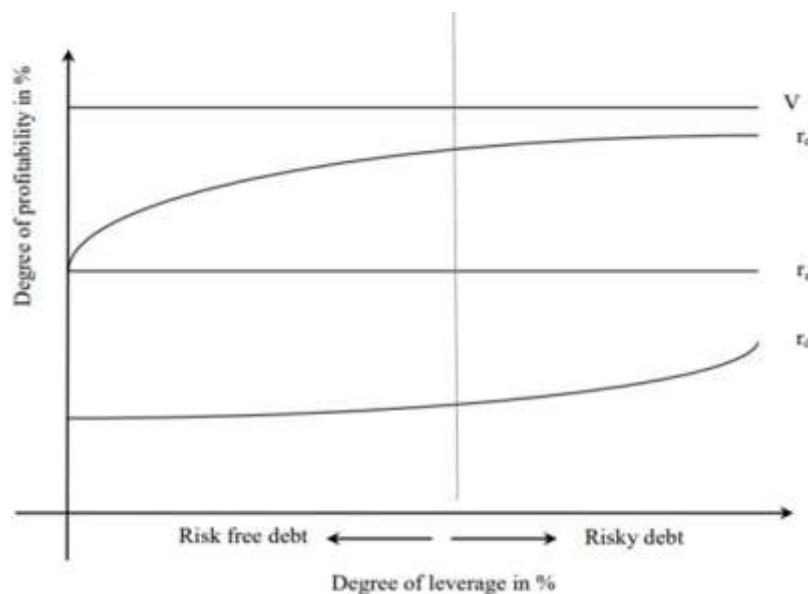


Figure 1. M&M model

Source: Own-processing

Instead, based on these equations, Modigliani and Miller concluded that shareholders' requirements for a greater return their capital do not appear up to a certain degree of debt, but grow steadily.

The M&M model is represented in figure 1.

where:

- V company market value in monetary units,
- $r_e$  costs of equity (profit of shareholders in %),
- $r_d$  costs of debt (profit of creditors in %),
- $r_a$  total costs on capital (profit of total capital in %),
- $\frac{D}{E}$  ratio of debt to equity (degree of leverage in monetary units).

Bonds are proof of risk. The debt-to-equity ratio is not affected by the expected return on debt. At a time when there is a greater demand for loans, credit institutions raise interest rates. This occurs when the expected return on capital grows in proportion to the ratio of debt to equity. In the risk zone, capital increases slower than the debt-to-equity ratio because it is less sensitive to the further increase in debt.

Therefore:

$$r_i = r_d + \frac{C_d}{C_e} \cdot (r_e - r_d) \tag{3}$$

where:

- $C_d$  debt in monetary units,
- $C_e$  equity in monetary units,
- $r_d$  costs of debt in %,
- $r_e$  costs of equity in %,
- $r_a$  total costs of capital in monetary units (costs of company capital funded only by equity).

This relationship is interpreted as follows: the expected rate of return on equity increases directly with respect to the debt/equity ratio (Bartosova, 2005). The theory of Modigliani and Miller is based on conditions that do not respect reality. Therefore the authors also considered income taxation.

This result is mathematically expressed in the following equation:

$$X^\tau = (1 - \tau)(X - R) + R = (1 - \tau)X + \tau R = (1 - \tau)\bar{X}Z + \tau R \tag{4}$$

where:

- $X^\tau$  earning after taxation in monetary units,
- $\tau$  margin tax rate of the company in % multiplied by 1/100,
- X earning before interest and taxes, can be expressed also by  $\bar{X}Z$  (multiplication of expected earning and random factor) in monetary units,
- R interest rate of debt in % multiplied by 1/100.

The authors then considered the personal income tax, the increase in creditors' requirements and other costs associated with the operation of the company. The purpose of the tax shield is to increase the company's market value by using external sources. Therefore:

$$PV\ TS = \frac{C_d \cdot R \cdot T}{i} = C_d \cdot T \tag{5}$$

where:

- PV TS present value of the interest tax shield in monetary units,
- $C_d$  debt capital in monetary units,
- R interest rate of debt in % multiplied by 1/100,
- T income tax rate in % multiplied by 1/100.

The market value of the company with debt is mathematically expressed:

$$V_Z = V_N + PV\ TS \tag{6}$$

where:

- $V_d$  value of the company with debt in monetary units,  
 $V_e$  value of the company funded only by equity in monetary units.

This theory is best because maximize the value of the company.

Taking income tax into consideration, the equation is therefore:

$$r_s = r_a + \frac{C}{C_d} \cdot (r_a - r_d) \cdot (1 - T) \quad (7)$$

According to financial practice, the M&M model did not consider the costs of financial difficulties. After the introduction of personal taxes, the main goal of the company is to minimize the present value of all taxes that are paid by the company. Therefore, one should choose a capital structure that maximizes profit after taxation. This is represented by the relative tax advantage of debt over equity:

Relative fiscal advantage of the debt

$$= \frac{(1 - T_p)}{(1 - T_{pe})(1 - T_c)} \quad (8)$$

where:

- $T_p$  rate of personal tax of interest in %,  
 $T_{pe}$  effective rate of personal tax of stocks profit in %,  
 $T_c$  corporate tax rate in %.

### 3. The Limits of the M&M Model and the Different Theories

The contribution of Modigliani and Miller was fundamental for the financial economy. Many researchers, including Stern and Chew (2003), agree that M&M propositions are the most famous and, at the same time, have had a strong impact on the development of economic-financial theory (Stern & Chew, 2003, p. 590).

Despite this, Breuer and Gürtler (2008) theorize the insignificance of the failure of the hypotheses. As such, they reported the following: taxes are neutral, there is no additional cost in the capital market, furthermore, investors and businesses are identical and have equal access to credit markets and, finally, financial information of the company reveal no fundamental information (Breuer & Gürtler, 2008, pp. 5-6).

The limitations of the M&M model are as follows:

- The risk classes are crucial and depend on them,
- It implies an objective allocation of the perspective on possible outcomes, rather than subjective e
- The hypotheses are based on the analysis of the partial equilibrium, rather than on the general one (Stiglitz, 1969, p.784).

For this reason, several theories have been developed including: Trade-off theory, Pecking order theory and Market Timing Theory of Capital Structure.

#### 3.1 The Trade-Off Theory

The trade-off theory is one of the theories that best represent the structure of capital and has been seriously considered after the debate on the M&M theorem.

In this theory, there is a decision maker who manages the company and evaluates the risks and advantages of different financial plans.

The basic assumption of this theory is as follows: when the corporate income tax is added, a benefit is created for the debt and this contributes to the protection of earnings from taxes. Since the function of the firm is linear and there is no debt compensation cost, there is 100% debt financing. This definition of Myers has maintained several aspects of the discussion: first, the goal is not directly observable. It can only be imputed by evidence but this depends on the addition of a structure; secondly, the tax code is much more complex than that of the theory: Graham (2003), in fact, provides a useful review of the literature on tax effects; furthermore, thirdly, bankruptcy costs must be inertial: the latter are also important and Haugen and Senbet (1978) provide a useful discussion of

them and finally, fourthly, transaction costs must take a specific form : the marginal cost of the adjustment must increase when this is greater. Leary and Roberts (2005) describe the implications of alternative assumptions on compliance costs.

There are two other trade-off theories: the static theory and the dynamic one. The static theory argues that companies have an optimal capital structure, determined through the exchange of benefits with the use of debt. Such an exchange has advantages and disadvantages: the advantage is that there is a debt tax shield while the disadvantage is the presence of potential financial difficulties. Agency costs are considered another risk factor (Jensen and Meckling, 1976). By including these costs in the theory, the company creates its own optimal structure by exchanging the tax advantage of the debt with both the costs of financial distress and agency costs. An important prediction of this theory is that firms target their own capital structures, i.e. if the effective leverage ratio deviates from the optimal one, the firm will adapt its funding behavior in such a way as to bring back the ratio of leverage at the optimum level.

In dynamic theory, on the other hand, an important role is played by the funding margin. For this reason, there will be some companies that will want to disburse funds in the following period while others will ask to raise liquidity. When the choice falls on raising funds, liquidity can take the form of debt or equity. This theory was supported by Stiglitz (1973). Dynamic trade-off models are used to consider embedded option values in deferring leverage decisions

to the next period. Goldstein et al. (2001) observe that a firm with low leverage today has the next option to increase leverage. This serves to decrease the level of leverage. Another author who analyzed this theory was Strebulaev (2007): he examined a model similar to that used by Fischer (1989); this theory foresees the detachment of leverage ratios from the optimal situation when companies will periodically finance due to transaction costs.

### *3.2 The Pecking Order Theory*

The other theory, not used in practice, is that of the hierarchical order. He argues that companies prefer to finance with retained earnings. They do not resort to external sources but to internal ones because they have less financial risk. The latter are chosen only when there is a reduction in the cost of capital. This theory was supported by Myers and Mailuf (1984), who argued that managers will look for internal sources first and then external ones.

### *3.3 The theory of Market Timing*

The last theory is that of Market Timing. This theory states that the company issues shares when it perceives that its shares are overvalued and repurchases them when it discovers that they are undervalued. It has two versions. According to the first version, agents must be rational; for this reason, the shares can be issued directly to the investor (Baker and Wurgler, 2002). According to the second version, however, it is claimed that the information is incorrect. Agents think they have complete information on time to market. According to Graham and Harvey, transfer time is a key point in timing it.

## **4. Conclusions**

The capital structure defines how an enterprise finances its investments through some combination of debt, venture capital, or mixed financial securities. The capital structure is therefore the composition or, precisely, "structure" of the financial capital of the balance sheet of a company.

The study of the structure of capital begins with the work of Modigliani and Miller of 1958, which reaches a conclusion that the structure of capital is irrelevant, under ideal assumptions about the absence of friction in the financial markets. Other theories besides this one were examined including the theory of trade-off, pecking order and timing market.

The theories of the trade-off of the capital structure start from the hypothesis that, in the presence of a friction of some form in the financial markets, debt presents benefits and costs for a firm. The trade-off between costs and benefits determines an optimal capital structure, corresponding to the level of debt that equates the marginal benefits to the marginal costs of debt.

The theories of the pecking order start from the removal of the hypothesis of Modigliani and Miller of perfect information. Specifically, they hypothesize that firms' management has more precise information about some aspect of firms' investment prospects. The conclusion that unifies the different theories of the pecking order is that companies will prefer to resort to the form of financing whose value is less sensitive than the particular information object of the information asymmetry.

Market timing theories have a more recent development, and start from positions at least partly distant from those of the more orthodox theories of trade-off and pecking order. In particular, the idea of market timing is based on the hypothesis, borrowed from the behavioral finance literature, that the market may give an inefficient valuation of a company's shares or its debt.

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